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ABSTRACT

The literature was reviewed to obtain sources of information relevant to the feasibility and utility of on-line data management systems, in support of the management and planning efforts in the research and development environment of the Air Force Human Resources Laboratory. The intended audience was middle-and upper-level management personnel. Documents were selected that would familiarize such personnel with the context and interrelationships of the many aspects of management information systems (MIS); that is, with how analysis, design, operation, evaluation, and user considerations affect MIS. The formal documentation of the literature reviewed resulted in this annotated bibliography of 112 references. (WDR)

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TECHNICAL LITERATURE REVIEW CONCERNING MANAGEMENT INFORMATION SYSTEMS

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The primary objective of the literature review was to obtain sources of information relevant to the feasibility and utility of an on-line data management system in support of the management and planning effort in the research and development environment of the Air Force Human Resources Laboratory. The formal documentation of the technical literature reviewed resulted in an annotated bibliography of 112 references.

The intended audience for the bibliography was middle- and upper-level management personnel. Documents were selected that would familiarize such personnel with the context and interrelationships of the many aspects of management information systems (MIS); that is, with how analysis, design, operation, evaluation, and user considerations affect management information systems.

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Technical Literature Review Concerning

Management Information Systems

The primary objective of the literature review was to obtain sources of information relevant to the feasibility and utility of an on-line data management system in support of the management and planning effort in the research and development environment of the Air Force Human Resources Laboratory. The formal documentation of the technical literature reviewed resulted in an annotated bibliography of 112 references.

The intended audience for the bibliography was middle- and upper-level management personnel. Documents were selected that would familiarize such personnel with the context and interrelationships of the many aspects of management information systems (MIS); that is, with how analysis, design, operation, evaluation, and user considerations affect management information systems.

Papers were selected for inclusion in the annotated bibliography according to three criteria: First, selected papers--in this instance monographs, technical reports, and review articles--should provide a manager with or direct him to procedures and methodologies of specific value to his situation. Second, selected papers should contain either experientially or empirically derived data and results directly applicable to the proposed communication information system. Third, selected papers should be informative about methods, objectives, philosophies, techniques and relative merits of feasible management information systems.

The scope of the literature search included: (1) information-seeking behavior of individuals in research and development environments; (2) use and user studies regarding on-line interactive information systems; (3) "human factors" analysis of on-line system software; (4) installation of planned change; (5) diffusion of technological innovation; (6) typical evaluations of data management systems (DMS); (7) comparison of machine-based DMS to other types; and (8) feasibility studies of on-line interactive DMS.

Although in a very broad sense any component, factor, or aspect of any computerized management information system affects user/system interaction, papers concerned solely with computer hardware design, internal data storage, structures, and similar technical details were rejected if they were not specifically applicable to the user/system interface.

Sixteen information sources were searched in the fields of computer science, information science, management, education, psychology, and social science, as well as numerous interdisciplinary, technically- and mission-oriented subfields associated with these areas. The information sources included the following: Annual Review of Information Science and Technology, Association for Computing Machinery's Curriculum Guide, Bibliographic Index, Books in Print, Computing Reviews, Education Index, Educational Resources Information Center (ERIC), Encyclopedia of the Social Sciences, Library and Information Science Abstracts, Information Science Abstracts, International Encyclopedia of the Social Sciences, National Technical Information Service (NTIS), Psychological Abstracts, Research in Progress, Social Science Abstracts, and Social Science and Humanities Index. Where possible, the search period covered from 1968 to the present.

Conceptually, bibliographic items were grouped into six areas: analysis, design, operation, evaluation, user studies, and all phases. These groupings were a matter of convenience and were used to provide conceptual clarity. The areas are not exclusive. An item placed in one category could have been placed in another category. For instance, item 51, "Cost benefits analysis in the design and evaluation of information systems," was placed in ANALYSIS rather than EVALUATION because the paper emphasized analysis of rather than evaluation of cost benefits.

In order to provide a description of the literature review, we first looked at the six areas of classification, then at each item, and then at the description of references within each area. Table 1 presents this information and indicates to which category individual bibliographic items were assigned. If, for instance, you wanted to check items that would more likely be concerned with users, you can turn to specific items listed in the USERS section. The numbers in Table 1 refer to the citation number in the Annotated Bibliography. The numbers in parentheses after some of the entries in the Annotated Bibliography refer to file numbers of documents on file with the Educational Resources Information Center (ERIC).

Table 1

Classification of Bibliographic References

Area	Item	Total Number	Approx. % of Total Items*
Analysis	14, 47, 51, 100	4	3.5
Design	1, 2, 5, 8, 12, 16, 17, 19, 25, 27, 28, 29, 31, 32, 39, 40, 41, 44, 52, 56, 63, 67, 87, 101, 107	25	22.5
Operation	6, 9, 10, 15, 20, 21, 35, 38, 43, 55, 57, 60, 61, 64, 65, 72, 76, 77, 88, 90, 91, 97, 99, 104, 106, 111	26	23.5
Evaluation	18, 34, 45, 48, 49, 50, 62, 69, 78, 79, 80, 82, 85, 92, 102, 103	16	14.2
Users	3, 4, 7, 11, 13, 22, 23, 24, 26, 30, 33, 36, 37, 42, 46, 53, 54, 58, 59, 66, 70, 71, 73, 74, 75, 81, 83, 84, 86, 89, 94, 96, 98, 105, 108, 109, 110, 112	38	34.0
All Phases	68, 93, 95	3	2.7

*Note: Due to rounding errors the cumulative percentage is more than 100%.

1. Ackoff, R. L. Management misinformation systems. Management Science, 1967, 14, 147-156.

Designers of management information systems make five assumptions which lead to major deficiencies in the resulting systems. Designers assume (a) most managers operate with a critical deficiency of relevant information; (b) the manager needs the information he wants; (c) organizational performance improves by better communication between managers; (d) if a manager has the information he needs, his decision-making will improve; and (e) a manager has to understand only how to use an information system, not how it works. Deficiencies caused by the assumptions can be remedied by designing the MIS as a subsystem of a management control system. Each type of management decision involved in the system should be carefully flowcharted.

2. Alesch, D. J., & Sumner, G. C. Method of evaluation for the Metropolitan Regional Council telecommunication system. (R-1000-MRC) Santa Monica, Cal.: RAND Corporation, May 1972.

In 1970 the Metropolitan Regional Council Inc. (MRC) of New York was authorized by the Federal Communications Commission to construct and operate a two-way microwave telecommunication system. Designed to serve local governments in the New York-New Jersey-Connecticut metropolitan area, it became operational in fall 1972. Alesch and Sumner describe the design developed for evaluating the system. The evaluation design concentrates on two aspects. First the Communication Impact Component measures changes in quantifiable communication phenomena between the baseline period and the follow-up period. The Management and Technology Component develops operational planning guides for system design, program content and format, and other behavioral and technological factors. The MRC-TV is evaluated in three phases.

3. Allen, T. J. Information needs and uses. In C. A. Cuadra (Ed.), Annual review of information science and technology. Vol. 4. Chicago: Encyclopedia Brittanica Press, 1968.

Allen reviews 58 papers concerned with the methodology of user studies and reveals a "striking alignment and relationship with several mainstreams of behavioral science research." The author argues that information user and use studies are tied directly to cognitive psychology, organizational psychology and sociology, and the sociology of science. It is suggested that more competent physical scientists and engineers should be attracted to the behavioral science and be given proper training.

4. Allen, T. J., & Gerstberger, P. G. Report of a field experiment to improve communications in a product engineering department: The non-territorial office. (Working Paper No. 579-71) Boston: Alfred P. Sloan School of Management, Massachusetts Institute of Technology, December 1971.

When the physical distance between participants is small and is considered to be appropriate for directed discussion, human communication is found to be more frequent and more effective. The authors studied this effect in a field experiment in a product engineering department, and though the sample was extremely small (ten subjects), the results prove highly suggestive for further research. In the experiment, no physical barriers, partitions, or walls were allowed in the workroom and no furniture was assigned to any one person. This arrangement was continued for one year. At the end of the period, significant improvement in interpersonal communication was noted among subjects. The average number of contacts among subjects and the frequency of contacts within the office increased, but subjective evaluation by the subjects' peers outside the office did not indicate any improvement in on-the-job performance. Further research should be conducted in this area, using a larger number of subjects and improved evaluation procedures.

5. Altman, J. W. Handbook of methods for information systems analysts and designers. Vol. II, Appendix II. Allison Park, Pa.: Synetics Corporation, February 1971 (AD 725 785).

This appendix presents a working technique for the analysis and design of information systems. The Total Requirements Analysis for Concept and Elements (TRACE) emphasizes information development as a complex series of goal-directed iterations rather than a simple sequence of well-directed steps. Personnel, software, facility, and support elements of information systems are discussed in detail. Intended as a practice-oriented handbook for information scientists with little or no experience in military information systems development.

6. Ammerman, H. L., & Melching, W. H. Man in control of highly automated systems. Alexandria, Va.: Human Resources Research Organization, May 1971 (AD 727 658).

Man must be provided with means of control if he is to function effectively as a system controller. He needs information that will tell him what the machine is doing, what it will be doing, how well it is performing, and where it may need assistance. He must

also be provided with proper procedures, decision rules, and control devices. Ammerman identifies the functions of man as a decision-maker and discusses man's basic function in a complex system, task activities for individual jobs, and the training and design of operational job positions.

7. Argyris, C. Management information systems: The challenge to rationality and emotionality. Management Science, 1971, 17, 275-291.

Argyris says that there is general agreement among management theoreticians and practitioners that MIS will probably perform many critical management functions in the future but that this future is still very far off. The author states that MIS specialists cannot yet deal with emotional problems caused by the impact of MIS and that they generally react "overrationally, which is an emotional response, and have difficulty in coping with their own and the executives' feelings and behavior." Argyris also predicts that management will exhibit certain forms of emotional reaction when faced with MIS, namely: (a) diminished feelings of essentiality; (b) limited freedom; (c) psychological failure; and (d) decreased executive power. Considerable attention is also given to methods for reducing the emotional impact of MIS. Also emphasized is the need for more personal competence in both systems technology and organizational communication.

8. Balk, W. L. The human dilemmas of MIS. Journal of Systems Management, 1971, 22(8), 35-38.

The author states that one of the most important needs in development of MIS is for analytical consideration of the impact and influence of communication at all organizational levels. He argues that systems people tend to be used by their technology rather than in use of it, and that in turn they resolve the design of information systems more to the convenience of technology than to the people who profess to use it. He concludes that systems people need to avoid dehumanization of the human community.

9. Boehm, B. W., Seven, M. J., & Watson, R. A. Interactive problem-solving--An experimental study of "lockout" effects. AFIPS Conference Proceedings, 1971 Spring Joint Computer Conference, 1971, 39, 205-210.

Literature on the design and management of time-sharing systems concentrates largely on evaluating computer system performance. However, as many researchers point out, the problem most difficult to evaluate is the nature of the user. Most data, then, attempt to evaluate the machine and improve man-machine systems by identifying the variabilities of the machine. For efficient operation of computer systems, however, optimization should be achieved around the variable characteristics of real-time human norms. Simple comparisons of off-line and on-line systems do not reveal such variables, and relevant data would consider both man and machine together in the time-sharing system.

In this study, Boehm et al. describe an approach for analyzing man-machine problem-solving systems through a controlled experiment on a time-sharing system. The subjects--graduate students with different degrees of computer and systems experience--were allowed various amounts of time of computer access. The amounts of time, termed "lockout" periods, depended upon the subject's success at completing certain tasks. The idea of "lockout" periods originated with Gold at MIT in 1967 in the belief that such a period, spent by the user in thinking about the task, might improve his performance at the machine ("Methodology for Evaluating Time-Shared Computer Usage," Unpublished doctoral dissertation, MIT, Cambridge, 1967). The authors interpret the results of the experiment, consider several subjective factors, and recommend further research in this area. Also given are several useful suggestions for improving system costs and efficiency.

10. Boffey, P. M. Psychology: Apprehension over a new communication system. Science, 1970, 167, 1228-1230.

Any new innovation should be considered not only by its isolate value to a system, but also by its impact, by how well it will work with existing or other added innovations. And though the intent of one innovation may be aimed at a single problem, its interaction with present system components may generate fierce resistance to its implementation within the system. For example, in the human system, drugs and alcohol may be harmless separately but fatal in combination. Hence, users and designers of information systems should be familiar with the particular functions and relationships of both old and new system components. Boffey details the significant effects of the early publication system of the American Psychological Association upon the functioning of other components in the psychology information system. Some implications for the innovation of MIS may be deduced from his account.

11. Borman, L., & Mittman, B. Interactive search of bibliographic data bases in an academic environment. Journal of the American Society for Information Science, 1972, 23(3), 164-171.

Borman and Mittman found a rather dramatic difference in the acceptance of on-line bibliographic searching by university research workers and university students. After careful training and individual help, university research workers typically rejected the on-line system in favor of more familiar, traditional search methods, while university students adopted the on-line system with enthusiasm and advantage. In this study, users accessed data bases in physics, astronomy, and urban systems through the Remote Information Query System (RIQS). Examples of introductory on-line training sessions are given.

12. Bose, A. Information system design methodology based on PERT/CPM networking and optimization techniques. Unpublished doctoral dissertation, University of Pittsburgh, 1970 (AD 711 670).

This dissertation endeavors to demonstrate that PERT/CPM or a modified version of it can be made into an information system design methodology. The derivative methodology would isolate the essential functional components of a system and allow priorities and time-cost relationships of the components to be revealed. Bose draws examples for his argument from a detailed analysis of the Lancaster evaluation of MEDLARS and agrees with Lancaster that in an information system there must be continuous monitoring of system operation. Bose does not favor the appointment of a "monitoring officer," though, because of the rather specious argument that a "monitoring officer" would not be directly involved in continuous system operation. Assignment of members of the system in-house staff to this task on a rotating basis could be one solution, however.

13. Buchanan, J. R., & Kidd, E. M. Development of a computer system with console capability for the Nuclear Safety Information Center. Proceedings of the 32nd Annual Meeting of the American Society for Information Science, 1969, 6, 151-158.

Buchanan and Kidd report that when on-line interactive terminals for input and search operations were installed at the Nuclear Safety Information Center it was found that most scientists and engineers preferred their searches done by an information specialist.

14. Carbonell, J. R. On man-computer interaction: A model and some related issues. Cambridge, Mass.: Bolt, Beranek & Newman, Inc., September 1967 (AD 666 666).

Carbonell presents a tentative analytical model of man-computer interaction. After a brief discussion of on-line interactions from the decision-making viewpoint, the author describes a model in which a human operator in an on-line interactive system seeks to solve a problem like debugging a program, testing models in practical applications, or performing information searching. Carbonell suggests that it is possible to consider most tasks in on-line interaction as information retrieval processes.

15. Carbonell, J. R., Elkind, J. I., & Nickerson, R. S. On the psychological importance of time in a time-sharing system. Cambridge, Mass.: Bolt, Beranek & Newman, Inc., September 1967 (AD 670 604).

Accessibility and response time of time-sharing systems are discussed in relation to user acceptance of the systems. Response times can be considered three ways. First, it is usually assumed to be the amount of lag between a specific query and a specific response, usually output or other signal to the user and transfer of control to him. Second, it may refer to a larger occurrence of a particular computational request or to some aggregate measure of the time-sharing system in general. Third, it may be thought of as the dynamic effect of variable loads on the computer; that is, response characteristics depend on different conditions such as type of command or amount of file manipulations required. Carbonell considers the third view in this report.

16. Chapanis, A. Relevance of physiological and psychological criteria to man-machine systems: The present state of the art. Ergonomics, 1970, 13, 337-346 (AD 714 706).

Chapanis discusses the incompatibility of criteria used in ergonomic and human factors research with the criteria used in the design and development of information systems and argues that the relationship between the criteria used in experimental work and those used in the practical world must be evident. System criteria are not unitary things that can be assessed by any single experimental variable, but rather are combinations of things--physical dimensions, for instance, and physiological responses and psychological feelings. A list of possible system criteria is presented.

17. Clapp, L. Interactive programming systems and languages. Newton, Mass.: Computer Research Corporation, July 1971 (AD 728 224).

In this state-of-the-art report Clapp discusses 67 time-sharing systems as well as on-line programming, language processing, computer graphics, information handling, engineering and business and management applications of computers, and computer-assisted instructional systems. Some major time-sharing systems, for example The University of Texas, are not included. A bibliography of 290 items is appended.

18. Cleverdon, C. Information and its retrieval. Aslib Proceedings, 1970, 22, 538-549.

In this summarization of the developments in information storage and retrieval over the past twenty years, Cleverdon sees three basic principles emerging: (1) an inverse relationship exists between recall and precision; (2) for a given system there exists an optimum level of indexing; (3) for a given system there exists an optimum level of specificity in the terms of an indexing language.

It is realized that these may not be hard and fast "laws" and that in some cases the principles may not be applicable. For instance, recent work by Karen Sparck Jones demonstrates that a relationship exists between depth of indexing and searching and of specificity of the index language. But, until this work is completed, the principles identified by Cleverdon are useful.

19. The CNOCOM/MIS pilot system study. (Final Report) Westlake Village, Cal.: Electronic Systems Division, Bunker-Ramo Corporation, April 1971 (AD 722 803).

The implementation and development of an interim man/machine subsystem for the Chief of Naval Operations Command/Management Information System is described. Three alternative configurations were investigated, namely a display capability integrated into a large computer, a display subsystem developed for an existing computer, and a display subsystem developed for a separate independent processor. After extensive tradeoff analysis, the third option was recommended.

20. Cook, K. H. An experimental on-line system for psychological abstracts. Proceedings of the 33rd Annual Meeting of the American Society for Information Science, 1970, 7, 111-114.

Cook previews the results of an 11-week field trial at Syracuse University of an on-line system accessing a data base of 35,000 abstracts taken from Psychological Abstracts. A total of 4,388 searches were conducted by 349 people from 75 terminals located around the campus. A thesaurus for the 65,000 different terms in the system was not available for users, and the results of the experiment indicate that such guides are needed to aid the searcher who attempts to discover the variety of words that express a single concept embedded in a data base.

Two features of the system, called SUPARS, that may prove useful in other environments are a telephone service enabling users to obtain instant aid when faced with problems, and a log whereby all interaction between users and the computer could be recorded.

21. Couger, J. D. Seven inhibitors to a successful management information system. Systems & Procedures, 1968, 19(1), 16-18.

Data concerning the management practices developed during implementation of management information systems was collected from 43 firms. From these data Couger identified seven inhibitors to successful installation of an MIS, namely: (1) insufficient identification of information needs; (2) incompatible design of independent systems for interdependent tasks; (3) different priorities for system and for firm; (4) poor feasibility studies; (5) failure of evaluation of system operation; (6) improper system analysis and design procedures; and (7) failure to account for external information demands.

22. Cravens, D. W. Predicting performance of information specialists. Journal of the American Society for Information Science, 1971, 22(1), 5-11.

Cravens analyzes empirical data from a study of the task-oriented information-processing behavior of information specialists and attempts to identify several predictors of job performance. Forty tasks performed by eighteen subjects were analyzed and a multiple discriminate function was developed which properly classified the 40 tasks into low and high performance categories. The author concludes that the five most significant variables were: (1) evaluation period for rejected information components, (2) task image state, (3) task performance rating, (4) total number of processed components, and (5) intelligence. Implications relevant to selection, training, and supervision of information specialists are also given.

23. Crawford, S. Informal communication among scientists in sleep research. Journal of the American Society for Information Science, 1971, 22(5), 301-310.

The communication network among scientists in sleep research was studied. The author found that 73% of the scientists who responded to her queries were interconnected, either directly or indirectly, with one another in a large network. But of this total only 15% originated or received contacts from six or more scientists. This small core group also produced a greater number of papers and were cited and read by a greater number of scientists. Information given to the members of this small group could be informally passed by them, either directly or through other members, to 95% of the other scientists in the larger network.

24. Crum, N. J. The librarian-customer relationship: Dynamics of filling requests for information. Special Libraries, 1969, 60(5), 269-277.

An information search system is characterized by a number of subsystems, of which one is the user interface. Crum outlines the various steps of the information retrieval process, beginning with the request and terminating with the delivery of a satisfactory response. Barriers to a successful retrieval cycle include personality, physical, psychological, contextual, and linguistic. The author sketches these barriers but discusses in detail the request interview. Other reports indicate that more useful requests are formulated when a user first writes them in free-form and then clarifies them by interaction with the interviewer. User-system interaction can occur at various stages of the information retrieval process and at one or more stages. Crum discusses only the request stage.

25. Cuadra, C. A. On-line systems: Promise and pitfalls. Journal of the American Society for Information Science, 1971, 22(2), 107-114.

Cuadra discusses the advantages and disadvantages of on-line interactive systems and illustrates the problems in light of his experience with the System Development Corporation. He points out that equal thought should be given to engineering both the system itself and the acceptance of it. Paradoxically, he suggests that one way of overcoming user disenchantment is to carefully undersell the advantages of interactive systems.

26. Danielson, T. M. The real world, the real manager, and the MIS project. In W. Goldberg (Ed.), Management information systems: Selected papers from MIS Copenhagen 70. New York: Auerbach, 1971.

Danielson discusses managerial behavior during design, development, and implementation of management information systems. Considering the conditions under which middle-managers operate, the author characterizes seven behavioral patterns of managers: (1) the "hurt feelings syndrome," (2) the "survival syndrome," (3) the "empire encroachment syndrome," (4) the "exposure syndrome," (5) the "run-rabbit-run syndrome," (6) the "Messiah complex," and (7) the "long live the Bronx and to blazes with the US syndrome." Danielson recommends keeping the rate of change to a reasonable level, or approximately one man-year of development work per year and 50 employees affected.

27. Davis, J. M. The transmission of information in psychiatry. Proceedings of the 33rd Annual Meeting of the American Society for Information Science, 1970, 7, 53-56.

Davis studied the diffusion of innovation in the field of psychiatry and found a delay of 10 to 20 years between the development of significant advances in fields related to psychiatry and references to such advances in the literature of psychiatry.

28. Dearden, J. MIS is a mirage. Harvard Business Review, 1972, 50, 90-99.

An organization of any size has an information system covering such large areas and including so many varied departments that no one designer nor, the author argues, even a group of system experts can design an integrative MIS. The components of a large organization are too diffuse in scope and different in function to allow them to be served by one information system. Therefore the author argues that one should not speak of "an MIS" but rather of a financial management information system, a planning management information system and so on.

29. Dray, S. Information exchange group No. 5. Science, 1966, 153, 694-695.

Dray identifies the main argument against the circulation of unreferenced research material, as suggested by the recent innovation of early publication developed by the American Psychological Association, as being concern for the necessity of "quality control."

Many scientists felt that some individuals would be credited with findings based on research that had not been properly evaluated by their peers.

30. Dudek, R. A. Performance, recovery, and man-machine effectiveness. 15 September 1971 (AD 729 964).

Dudek attempts to assess human performance under continuous operations or long-term activity. (Long-term activity is defined as two hours or more of activity.) Vibrations, physical loading, and thermal stresses are investigated to determine optimal or near-optimal work/rest schedules for individuals and to yield high performance with least depreciation over time followed by rest-recovery to an acceptable high performance.

31. Engelbart, D. C., English, W. K., & Evans, D. A. Study for the development of computer-augmented management techniques. Menlo Park, Cal.: Stanford Research Institute, 1971 (AD 855 579).

Interim technical report of the Augmented Human Intellect Research Center at Stanford Research Institute describing direct augmentation of human intellectual effectiveness by means of full-time use of special on-line computer aids. A major development of the AHIRC is the On Line System (NLS), a sophisticated text-manipulation system with graphic capabilities. As an on-line aid to management control the NLS's chief value lies "in the process of manipulating a file--studying it, making modifications, adding new material as an integrated process. . . ." A detailed discussion of the NLS work-station console, structured text capability, and system usage is given.

32. Fetter, R. B., & Carlisle, J. N. Man-computer interaction in a decision-making environment. New Haven, Conn.: Yale University, 1971 (AD 722 336).

Fetter compares the interaction of users with teletype and then with video consoles. Although users spent more time on the video and committed a larger number of errors (presumably due to an especially complicated transmission procedure) they also retrieved a larger number of documents. The difference lies in the ability of users of video consoles to control the output of their searches with an abort option. Able to cut off output at the end of any page, users were more willing to retrieve larger numbers of documents for scanning. Fetter suggests, as do other studies, that the very fast response speed of video consoles also encourages more retrieval.

33. Gleason, E. M. The role of the period of transition in the implementation of information systems. (Final Report) Fort Lee, Va.: Army Logistics Management Center, 1968 (AD 672 838).

In Chapter 3 of his paper reporting the role of transition in the implementation of information systems, Gleason details the problems of personnel-management communication during the transition period.

34. Gold, M. M. A methodology for evaluating time-shared computer system usage. Pittsburgh: Carnegie-Mellon University, 1967 (AD 668 084).

Gold, the originator of the concept of the "lockout period," offers a tested method for evaluating the cost-effectiveness of a time-shared computer system.

35. Green, J. S. GRINS, an on-line structure for the negotiation of inquiries. Studies in the Man-System Interface in Libraries. (Report No. 4) Bethlehem, Pa.: Center for the Information Sciences, Lehigh University, 1967 (AD 660 089).

Problem solving is a dynamic process in which the question negotiation activity purposes to obtain an information goal with the least amount of effort. The author describes an on-line computer program called GRINS in which changes in strategy are available. When the question negotiation is judged by GRINS to be as appropriate as possible, a search is made of the available documents and a ranked list of the 63 most relevant documents is produced.

36. Hagerstrand, T. Innovation diffusion as a spatial process. Chicago: University of Chicago Press, 1967.

Intraorganizational communication is affected by several constraints such as social networks and spatial arrangements. Hagerstrand studied the influence of the neighborhood effect and the territorial concept on human communication.

37. Harmon, G. Information need transformation during inquiry: A reinterpretation of user relevance. Proceedings of the 33rd Annual Meeting of the American Society for Information Science, 1970, 7, 4-43.

As the extent and rate of innovation increases, what a user considers relevant changes. Harmon reinterprets two prior investigations of relevance, and develops a four-stage user information-need model. He suggests that a user proceeds from a condition of insufficient, unordered information needs to a condition of sufficient, ordered information in which, being able to state a more precise information need, he can pick and choose those elements of his information which are relevant. Implications of Harmon's suggestions are not limited to information retrieval but also to training of EDP personnel. Progress of such training could be gauged by the four states of the Harmon model.

38. Head, R. V. SMIS in Denver: A conference report. Datamation, 1971, 17(22), 57.

The author reports that, for several reasons, large firms are (temporarily) abandoning the practice of direct manager-computer interaction. He suggests that solving management's general rejection of interactive systems would require improvement of the user interface and, sadly, "a new generation of (computer-oriented) managers."

39. Herner, S., Leyman, E., & Herner, M. A study to determine the feasibility and design for a New England Technical Information Referral Service. Washington, D.C.: Herner and Company, 1969.

The authors studied the feasibility and possible designs of a proposed New England Technical Information Referral Service. The technical information service would serve both large firms which lack such facilities and small companies which cannot afford them. A centralized information facility is recommended which would have a number of "industry desks" geared to a particular industry or groups of similarly-oriented industries. The "desks," staffed with industry specialists and information specialists, would be in close liaison with industrial clients and would provide them with needed technical products and services. The products and services would include acquisition, processing, and storage of relevant materials; SDI systems; reference services; preparation of indexes, abstracts, bibliographies, and state-of-the-art reports; organization of industrial-oriented data bases; training programs for in-house and client personnel; and perhaps advertising and public relations.

40. Hormann, A. M. Planning by man-machine synergism: A characterization of processes and environment. Santa Monica, Cal.: System Development Corporation, 1970 (AD 704 810).

Hormann attempts to couple the complementary facilities of man and machine for optimal planning. The machine can be of aid when man is able to: (a) control the specificity of search of the machine; (b) instruct the machine to display information in a variety of formats; (c) direct the machine to present certain decision-aiding tools; (d) delegate to the machine more detailed, routine functions in order to free himself for creative ideas; (e) have the machine remind him with a checklist of crucial issues and factors at selected points; (f) let the machine handle sub-processes with built-in programs that only give notice when something is wrong or unusual. The author suggests that an evolving set of computer programs termed Gaku will allow this cooperation between man-machine faculties.

41. Ide, E., & Salton, G. User-controlled file organization and search strategies. Proceedings of the 32nd Annual Meeting of the American Society for Information Science, 1969, 6, 183-191.

This report describes two procedures for directing the user toward his information requirements by employing relevance feedback. The first procedure weights the query terms associated with documents. Query terms associated with documents known to be relevant to the information need are weighted positively; terms associated with documents known to be not relevant to the need are weighted negatively. Thus, positive weighting (or positive feedback) directs queries toward similar documents that would fulfill the information need, and negative weighting (or negative feedback) guides queries away from documents not relevant to the information need or, in the case of zero retrievals, toward a useful request statement. Of course, this procedure would prove most useful on an on-line interactive system.

This second procedure, termed "document space modification," attacks the relevance problem in the opposite direction. Instead of modifying queries, the procedure modifies the index terms based on the relevance feedback associated with particular queries. That is, if the feedback indicates that a document is relevant, then the index term associated with that document is identified and similar documents are indexed similarly. Hence, documents are indexed according to the relevance of requests rather than to some abstract or artificial principle.

42. Johns Hopkins University SoGSIP Study Group. Some preliminary results from a survey of graduate students in psychology. (OC-3/71-TR No. 15). Washington, D.C.: American Psychological Association, Office of Communication, 1971.

This report indicates that graduate students and faculty members (classified according to region and size of department) of psychology departments in educational institutions in the United States resorted to different information channels to satisfy their information needs. Data obtained from questionnaires (which elicited a response rate of 40%-50%) give evidence that students and faculty differed on the sources of their most valuable information. The graduate students named equally as their most valuable information source "professional journals" (59%) and "faculty members" (58%). Other sources, in order, were: "fellow graduate students" (43%), "courses and seminars" (35%), "textbooks" (30%), and other "nonfiction books" (21%). The faculty generally agreed with this ordering but differed in their ratings as to importance. A clear majority (80%) of the faculty rated "professional journals" as the most important information source, followed by "faculty members" (50%), "graduate students" (37%), "courses and seminars" (28%), and "professional meetings" (27%). In general, faculty members used journals and informal channels more extensively than did graduate students, who relied on books and short-distance interpersonal networks.

43. Kanter, J. Management-oriented management information systems. Englewood Cliffs, N.J.: Prentice-Hall, 1972.

Kanter suggests that the backlash against management information systems in the late 1960s obscured the real value of such systems. One difficulty was that MIS meant many things to many people: from inventory report generators to computer-modeling simulators of complex marketing environments. The author simply defines an MIS as a system that aids management in making, carrying out, and controlling decisions and then proceeds to discuss MIS in concrete terms. The audience for the book is the technically oriented, non-EDP manager. Development, design, functions, technological factors relating to implementation, and management aspects of MIS are considered. Kanter also indicates how managers should get involved in computerization of information systems and what they need to learn in order to do so. Chapters contain bibliographies, and case studies are frequently given.

44. Katter, R. V. Design and evaluation of information systems. In C. A. Cuadra (Ed.), Annual Review of Information Science and Technology. Chicago: Encyclopedia Britannica, 1969.

Katter reviews 181 papers published in 1967 and discusses cost-benefits, forecasting, simulation, modeling, evaluation criteria, management information systems development, and constraints on system operation. In particular, the author identifies a "system redevelopment cycle," which includes analysis, synthesis, and evaluation of information systems. The term is effectively used for two reasons. First,

implementation usually implies "replacement of an older interactive (facility) by one that is newer, usually more expensive, and presumably more effective." Second, the evolution of the user interface design in on-line interactive systems closely follows the evolution of user behavior as it is influenced by the availability of additional problem-solving facilities.

45. Katzer, J. The development of a semantic differential to assess user's attitudes towards an on-line interactive reference retrieval system. Journal of the American Society for Information Science, 1972, 23(2), 122-127.

A semantic differential (SD) is a measurement tool used to assess attitudes toward a variety of objects or concepts. Each SD consists of a number of bipolar adjective scales to which a respondent reacts with regard to an object or concept. The responses are then grouped into one or more independent clusters. Katzer attempts to identify those clusters which users apply to on-line reference retrieval systems when he reacts toward such a system. A sample of 91 students and staff at Syracuse University who had some familiarity with the SUPARS (Syracuse University Psychological Abstracts Retrieval System) were each given SD packets. The results indicate that users tend to evaluate the SUPARS information system in terms of the effectiveness, desirability, and enormity of the system. However, since there were several large variances with Katzer's results and other studies, the author suggests that the experiment be replicated.

46. Kegan, D. L. Measures of the usefulness of written technical information to chemical researchers. Journal of the American Society for Information Science, 1970, 21(3), 179-186.

Kegan found that industrial researchers considered some pieces of information "relevant" even though the information was not directly used or cited in their work. He suggests that information influential to one's cognitive structure is as "useful" as information used in citations or hard output.

47. Kennevan, W. J. MIS universe. Data Management, 1970, 8(9), 22.

Kennevan defines an MIS as "an organized method of providing past, present, and projection information relating to internal operations and external intelligence. It supports the planning, control and operational functions of an organization by furnishing uniform information in the proper time-frame to assist the decision-making

process." He suggests that an MIS encompasses not only hardware and software but also methods and policies dealing with the human factors of management and personnel.

48. King, D. V., & Lancaster, F. W. Costs, performance, and benefits of information systems. Proceedings of the 32nd Annual Meeting of the American Society for Information Science, 1969, 6, 501-505.

A framework for evaluating cost/performance benefits of an information system is given by King and Lancaster. Cost is conceptualized as the input of resources to a system. Performance refers to evaluative criteria directly controlled by the system such as recall/precision, search time, rate of response. Benefit is system output evaluated in terms of value, impact on the user and on adjacent systems, dividend on investments of money and effort, and several intangible results of using the system.

49. Korfhage, R. R., & DeLutis, T. G. A basis for time and cost evaluation of information systems. Report RM-69-6. Lafayette, Ind.: School of Industrial Engineering, Purdue University, 1969 (ED 050 797).

Korfhage and DeLutis suggest a two-level model for information storage and retrieval systems. The system defines the user; sources of data; hardware, software, and personnel actually involved in storage, search, and retrieval activities; and the system funder who approves selection of system components. The funder, the user, and the data sources comprise the outermost level which the authors term the "ectosystem." All levels and components not included in the ectosystem belong in the innermost level which is termed the "endosystem." Each level and component in the endosystem functions in processing and storage activities. The authors suggest that the endosystem, or actual system performance, can be evaluated by identifying the amount of time required to complete a requested service. The time required is a function of the interaction between various hardware/software configurations and characteristics of user/client groups. System components and configurations can be chosen in accordance with the performance of the endosystem and the cost of the ectosystem required to achieve that level of performance.

50. Lancaster, F. W., & Climenson, W. D. Evaluating the economic efficiency of a document retrieval system. Journal of Documentation, 1968, 24(1), 16-40.

The relationship between precision/recall ratios and the professional skill and salary requirements of personnel is discussed by the authors. The system is viewed not from a standpoint of theoretical efficiency but rather from one of practical operational results. Lancaster and Climenson relate recall/precision ratios, personnel factors, and cost-effectiveness requirements in a "system parameter network."

51. Learman, I. Cost-benefits analysis in the design and evaluation of information systems. AFIPS Conference Proceedings, 1971 Fall Joint Computer Conference, 1971, 39, 469-476.

It is difficult to assess cost-benefits in a system because of the number of different parameters involved throughout its development and operation. Learman suggests that cost-benefits analysis should occur in two phases. The first phase is involved in the planning and design of the system, and will indicate alternative features and the feasibility of implementation of suggested designs. The second phase is involved with the operation and evaluation of a realized system. Effectiveness and deficiencies of the system are identified and modifications are made. Learman's approach is based on a hospital information system.

52. Line, M. B. On the design of information systems for human beings. Aslib Proceedings, 1970, 22, 320-335.

Line argues that designers of computerized information systems have failed to consider human needs and prejudices. The only "success" that system designers have achieved has been the introduction of mechanical refinements to information storage and retrieval systems. As a result, many users prefer more traditional methods of information acquisition (as illustrated by the TIP physics information retrieval system at MIT, where some physicists still prefer to browse in the library) or informal communication channels such as conferences, meetings, and telephone communication. Use of interactive systems has also been restricted, consciously and unconsciously, to users with fairly technically-oriented backgrounds. Line, particularly concerned with the long-term effects of computerized information systems, suggests that since computers cannot draw inferences, "there is a serious danger that the prolonged use of a computer system could narrow one's horizons and range of interest in a way that could be very damaging to the progress of science [since] the major advances . . . are made by the imaginative leap, the seeing of similarity in two apparently disparate areas . . ." Finally, he suggests that users' needs and preferences should be of primary importance in the design of information systems, and that identification of needs and inherent feelings could be accomplished with the aid of psychology and sociology.

53. Line, M. B. The information uses and needs of social scientists: An overview of INFROSS. Aslib Proceedings, 1971, 23, 412-434.

This overview of the INFROSS project indicates that British social scientists use abstracting and indexing services more for current awareness than for specific searches. Lack of review articles, translation services, and bibliography and abstracting services are seen as major faults in the formal communication network.

54. Line, M. B., Brittain, J. M., & Cranmer, F. A. Information requirements of social scientists in government departments. (Research Report No. 2) Investigation into Information Requirements of the Social Sciences. Bath, England: Bath University of Technology, 1971 (ED 049 774).

Line concludes from this study that abstracts are used much more by social scientists employed by educational institutions (the research group) than by those employed by the government (the applied group).

55. Lowe, T. C., & Roberts, D. C. On-line retrieval. Bethesda, Md.: Information, Incorporated, 1970 (AD 706 866).

The size of document collections, their growth rate, the deficiencies of indexing schemas and personnel, and the cost of manual indexing have increased the importance of finding a suitable automated document classification scheme. This system should include not only the actual indexing of documents but also automatic generation of thesauri. Lowe describes an on-line retrieval system which attempts automatic classification of documents through a new approach--the concept vector technique. Terms associated with known relevant documents are given concept-weight rankings and applied to a search query. The process is known as document-document searching. Operation of the dialogue processor, two examples of actual user dialogues, file construction techniques, and a description of the subprograms of the dialogue processor are given.

56. Martin, T. H., & Parker, E. B. Designing for user acceptance of an interactive bibliographic search facility. Stanford, Cal.: Stanford University, 1971.

The authors recommend several suggestions for improving computer-based information systems, based on their experience with the Stanford Public Information Retrieval System (SPIRES). The recommendations are: (1) design goals should be in accordance with the information

needs and habits of users in a target population; (2) user profiles should be formulated from user studies and should be adaptive to several levels of user-system interaction; (3) design modules should enable several different user-system interactions; (4) features which continuously collect user-related data should be an inherent part of any system; (5) several alternative system configurations should be stated and evaluated and the optimum design chosen; (6) post-operation evaluations of system should be conducted; (7) the final system design should be the result of extensive data-gathering efforts in the prior stages of test and evaluation. It is emphasized that these recommendations are the results of real-world experience.

57. McAllister, C. On-line library housekeeping systems: A survey. Special Libraries, 1971, 62, 457-468.

This review discusses all operational on-line library "housekeeping" systems in operation as recently as September 1971. On-line procedures, files and indexes, batch and on-line data base updates, and terminals are discussed as well as, in appendix format, operational information on each of the above systems.

58. Melton, A. W. Human performance in information processing and storage. Ann Arbor, Mich.: Department of Psychology, University of Michigan, 1967 (AD 656 709).

Melton develops a taxonomy of human performance with regard to information processing. A macroscopic level is investigated which classifies tasks into information conserving (one-to-one mapping of stimuli to response) and microscopic level is investigated which emphasizes the human internal processing capabilities and limitations that are inherent in skilled performance. The results indicate several stages in the processing of specific stimuli: (a) a preprocessing stage which encodes stimuli for later processing; (b) a recognition/identification stage which compares the encoded stimuli with stored replicas similar to the stimuli; (c) a response selection phase which "matches" an appropriate response with the stimuli; and (d) a response execution phase which generates the muscle activity appropriate to the particular response. Melton also suggests that memory has a key role in all information processing tasks.

59. Merton, R. The Matthew Effect in science. Science, 1968, 159, 56-63.

Merton applies a parable from Matthew to scientific notoriety. The Matthew text says, roughly: he who has, shall have

much more; and he who has less, shall have much less. The author argues that the head of a research team receives more than his share of the credit for the team's findings, and as a result becomes a "star." The "light" from the "star" attracts a tide of reprints, editorial instructions, reviews and state-of-the-art reviews, appointments to moderate conferences, and so on and so on. From this "exposure" the research head hopefully absorbs enough information to advance his team and reenhance his position. It is unclear how the notoriety of the head affects the morale of the men under him.

60. Mikesell, M. W. The borderlands of geography as a social science. In M. Sherif & C. Sherif (Eds.), Interdisciplinary relationships in the social sciences. Chicago: Aldine, 1969.

Mikesell finds that the interdisciplinary diffusion of geography into other areas is, in contrast to the rapid diffusion of Shannon's communication theory, rather slow and inefficient.

61. Miller, R. B. Response time in man-computer conversational transactions. AFIPS Conference Proceedings, 1968 Fall Joint Computer Conference, 1968, 33, 267-277.

Response time is not an absolute measure of system performance. Miller relates response time requirements to 17 states of user input ranging from the simple single key-stroke action to the more involved "solve my problem" request. The experiment's results show that, as delay increases between input and output, human efficiency drops until a point of stalemate is reached; activity extended beyond this point tends less and less toward on-line interactive dialogue. Miller's findings indicate that speed is not by or of itself a virtue. He suggests that further research be conducted to ascertain optimum response time and acceptable variations of response time in relation to user requests.

62. Minker, J., Crooke, S., & Yeh, J. Analysis of data processing systems. College Park, Md.: Computer Science Center, University of Maryland, 1969.

Minker et al. review hardware and software monitoring, simulation, and analytical modeling and suggest that one attractive evaluation technique is simulation, validated by actual system performance as determined using internal software monitoring.

63. Mitchell, M. B., Smith, R. L., & Westland, R. A. Technique for establishing personnel performance standards (TEPPS): A procedural guide. (2nd ed.) Santa Monica, Calif.: Dunlap & Associates, 1968 (AD 665 689).

Not a few years ago, the cost of computer time, in contrast to cost of user time, was high. Users of computer systems were an elite corps of select, highly-skilled, and particularly motivated specialists. But today, time-sharing has significantly decreased the cost of computer time to user time, and, as a result, the pool of potential users has widened. Secretaries, assistants, and managers unfamiliar with computer systems and terminals will avail themselves of computers. Mitchell et al. suggest a detailed list of human factors relevant to today's unstructured user pool that should be heeded for optimal system performance.

64. Moore, M. R. Pitfalls in planning an EDP installation. Management Services, 1968, 5(5), 25-32.

Moore lists a number of inhibitors, e.g., to successful implementation of computerized information systems, and suggests that an information system audit be used as a control technique to minimize these factors.

65. Morton, M. S. S. Management decision systems: Computer-based support for decision making. Boston, Mass.: Graduate School of Business Administration, Harvard University, 1971.

Morton reports results of an experiment aimed specifically at business decision-making. In the experiment, a group of managers controlled a computer model offering several alternative production schedules, and reached agreement on appropriate schedules in half a day. Formerly, using an off-line information system, the managers took up to 20 days to reach agreement. This experiment, directly involving managers in the operation of a computer system, aided managerial acceptance of the interactive system. Morton also extensively discusses the background and concept of how a manager operates in a business environment.

66. Mote, L. J. B. Personal patterns of information use in an industrial research and development laboratory. Journal of Documentation, 1971, 27(3), 200-204.

In this report of the human influence on information flow in an industrial R&D environment, Mote notes that high-ranked scientists and technologists made fuller use of information facilities than their lower-ranked colleagues. The information channels rated were journals, technical reports, progress reports, professional papers, and external ("inter-library") loans and requests. Mote includes four tables of raw data.

67. O'Black, M. J. Building a successful MIS. Journal of Systems Management, 1971, 22(4), 9-15.

There is a growing tendency toward the design of MIS in modular form but O'Black cautions against this approach. The author argues that it is difficult to break MIS operations into modules because the development of MIS is a continuous test-evaluate-implement process with each stage highly interdependent on the other; and that modules design is inefficient insofar as cost-effectiveness is concerned because it fails to incorporate the existing system and the knowledge derived from its prior operation.

68. Olsen, H. A. The economics of information: Bibliography and commentary on the literature. Washington, D.C.: ERIC/CLIS, 1971 (ED 044 545).

Olsen compiled an extensive list of sources from the literature of the economics of information, which he defines as "the concepts and tools of economics as they apply to information activities." The literature is categorized into 14 topics, and includes over 300 items ranging from theoretical studies to applied analyses. In an extremely lucid commentary on the literature, Olsen suggests that the impact of economists on information activity in the 1970s may resemble the impact that psychologists had on information activity in the 1960s.

69. Paisley, W. J. Improving a field-based "ERIC-like" information system. Journal of the American Society for Information Science, 1971, 22, 399-408.

Paisley uses the experience of Educational Resources Information Centers (ERIC) to illustrate the effects of ignoring the human factors impact on an innovation. The original objectives of ERIC included: (1) gathering, abstracting, indexing, and disseminating significant literature in the field of education and educational research; (2) reviewing and placing the collected information in perspective; (3) making the ERIC data base available to the public. In five years of operation, the ERIC system has done a stellar job on the first two

objectives but has noticeably failed on the third. The use--and even knowledge--of ERIC is restricted to university-level researchers and professors and includes little of the general public. There are two reasons for this. First, the target population and its information needs and information-seeking behavior were not studied. Potential users were neither defined nor appraised, preferred channels for obtaining information were not ascertained, methodology for diffusing the innovation was not formulated, and no feature for user feedback and suggestions was included. The second reason--and it can be argued that it follows from the first--was the choice of display of the user interface--microfilm. Microfilm services and photocopy provisions are largely restricted to university libraries, technical centers, or major public libraries such as Chicago Public or New York Public, and microfilm readers are at present of poor resolution quality. Paisley emphasizes the importance of discovering who uses an innovation and how it will be used. That point cannot be emphasized too often.

70. Perruci, R., & Rothman, R. A. Obsolescence of knowledge and the professional. In R. Perruci, & J. E. Gerstl (Eds.), The engineers and the social system. New York: Wiley, 1969.

Perruci and Rothman examine the difference in information-seeking behavior between Ph.D. and non-Ph.D. technologists, specifically with how well they had kept themselves informed of new knowledge in their field. The authors asked 3200 graduate engineers to determine the extent of knowledge gained from their courses in college and the extent of their awareness of new scientific and technical fields. In both respects, the authors found considerable difference between the two groups of subjects. In order to isolate the factor of a Ph.D. or non-Ph.D., two negative correlations were made: (1) amount of experience with knowledge gained from college and with current awareness; (2) amount of technical responsibility within the firm with obsolescence. Both procedures are admittedly subjective estimates and while the absolute reliability of the authors' data should be considered, the fact that it revealed differences was significant.

71. Price, D. J. de Solla. Little science, big science. New York: Columbia University Press, 1963.

Information transfer networks may be classed as formal and informal. In recent years studies have shown that informal communication networks may be more important than formal information systems, insofar as the transmission of new information is concerned. In this book, Price was the first to identify the "invisible college," or a small group of individuals in particular research fronts who communicate amongst themselves through preprints, manuscript circulation,

personal visits, meet[illegible]s at conferences and seminars, telephone conversations, and other informal means outside the formal, journal-oriented information systems.

72. Price, D. J. de Solla. Is technology historically independent of science? A study in statistical historiography. Technology and Culture, 1965, 6, 553-568.

Price indicates that technologists are apt to disregard recent findings in basic science in the course of their research. He suggests that, unlike the development of a concise, consistent body of knowledge by colleagues and specialists in a scientific field, technological literature grows much more diffusely. Information useful to technologists comes from a number of fields, even from different information systems, and new findings introduced from basic science may take as long as three decades to surface.

73. Price, D. J. de Solla. Some remarks on elitism in information and the invisible college phenomenon in science. Journal of the American Society for Information Science, 1971, 22(2), 74-75.

In recent remarks, Price discusses the difficulty of identifying members of the "invisible college," and the distortions which have crept into the concept since its publication in 1963.

He suggests two factors which might be considered as starting points for the mapping of communication networks among scientists and technologists. First, the number of individuals in an invisible college of a given area of research is very small, or, roughly, the square root of the number of individuals in the research front. And second, members of the invisible college of a research front are connected not in any formal manner but rather through closely related, high-quality work recognized in an extensive network of cross-citations and informal interpersonal actions. Two other factors make identification of the invisible college difficult: (1) some persons in the research front have made significant contributions to it and have close interactions with members of the invisible college but are not actually considered to be members of the college; and (2) people, books, papers and concepts may enter the invisible college with no advance notice or, when they have entered, we do not know the precise time.

The invisible college concept has now become distorted. Many people view it as a "power group," a "restricted, fixed-membership club," or as a "mechanism thrown up automatically by the scientific community," all of which, Price remarks, are false.

74. Rosenberg, V. 12 factors affecting the preferences of industrial personnel for information gathering methods. Information Storage and Retrieval, 1967, 3(3), 95-100.

The author investigates why individuals prefer certain methods for information gathering and what characteristics of the methods are important. Data from the structured questionnaire indicate that research and non-research personnel in industry and government do not appreciably differ in their evaluations of information gathering methods, and that the preference for a given method reflects the ease of use of the method rather than the quantity or quality of information expected. Rosenberg suggests that the basic parameter for an information system for industry should be the system's ease of use rather than the amount of information offered. "Ease of use" may be defined as time, distance, or intellectual effort, and it is suggested that further research should be conducted in this area.

75. Rubenstein, A. Explorations on the information-seeking style of researchers. In C. E. Nelson & D. K. Pollock (Eds.), Communication among scientists and engineers. Lexington, Mass.: Heath Lexington Books, 1970.

For a number of years, Rubenstein and his colleagues at Northwestern University have conducted information-use studies of the management of research and development. In this particular experiment, the authors studied the influence of a new free information service on the information environment of an organization. The subjects, 18 X-ray crystalographers in nine Chicago area laboratories, exhibited no long-term, observable changes in their information-seeking behavior during the three years the experiment was conducted. The authors also discuss the innovation of a card-reporting system for indicating the progress of searches, the introduction of facsimile transmission, and the initial request interview.

76. Sackman, H., & Citrenbaum, R. L. (Eds.) On-line planning. Englewood Cliffs, N.J.: Prentice-Hall, 1972.

Sackman and Citrenbaum edit this collection of ten papers on on-line interactive planning, a recent major innovation expected to radically affect planning theory and practice. Three sections describe and explain the nature and principles of on-line planning, its application to planning projects, and empirical validation through certain techniques. New approaches to management include project planning with on-line techniques, interactive graphics, resource allocation procedures, and on-line simulation. Experimental analysis of on-line planning in terms of human factors and advanced recording and reduction techniques is discussed.

77. Sackman, H., & Gold, M. M. Time-sharing versus batchprocessing: An experimental inquiry into human problem-solving. Santa Monica, Cal.: System Development Corporation, 1968.

The experiment by Sackman and Gold compared human problem-solving capability in time-sharing and batch processing systems. Results indicate that time-sharing may be the better mode for human problem-solving. Time-sharing used more computer time but exhibited greater problem-solving effectiveness, quicker decision-making at both the beginning and end of the problem-solving period, more consistent pacing, and greater acceptance of problem-solving computer systems.

78. Salton, G. A comparison between manual and automatic indexing methods. American Documentation, 1969, 20(1), 61-71.

Comparisons between SMART, the automatic indexing system, and MEDLARS, the manual indexing system, are difficult because of the enormous difference in the size of the respective data bases. Salton's data base cannot match the 1.2 million items stored in the entire MEDLARS system, but the latter system's data base can be organized into very small subsets of comparable size to the SMART data base. Salton did this, and reports that the SMART system was at least no worse than MEDLARS. Results also indicate that the automatic indexing method normalized the retrieval process; that is to say, of the 18 searches among 273 documents, SMART never equalled the best MEDLARS retrieval but it also never came up with zero retrievals, which MEDLARS did occasionally.

79. Salton, G. Evaluation problems in interactive information retrieval. (Tech. Report 69-39) Ithaca, N.Y.: Department of Computer Science, Cornell University, 1969.

As suggested earlier, evaluation measures in addition to recall/precision may be warranted by special situations or retrieval systems. Salton suggests that the time or cost per relevant citation may be a more useful measure than precision when evaluating on-line interactive systems. He also points out that, though computer costs and user efforts involved in conducting individual searches on time-sharing systems are very difficult to measure, such criteria would be more useful than document-against-document comparisons.

80. Salton, G., & Lesk, M. E. Relevance assessments and retrieval system evaluation. (Tech. Report 68-25) Ithaca, N.Y.: Department of Computer Science, Cornell University, 1968.

This careful experiment explored the relationship between recall and precision estimates and relevance judgments. Eight human judges judged the relevance of documents on a scale of simply "relevant" and "not relevant." Inter-judge communication was carefully monitored, a consistent set of documents and an evenly educated and experienced set of judges were chosen, and relevance was closely defined. Relevance judgments were gathered by query author, by another subject expert, by author or expert, and by author and expert.

Three retrieval methods were evaluated by the SMART system and then subjected to the relevance judgments of the eight judges. The human judgments ranked the three retrieval methods in the same order as SMART. Implications are that recall/precision measures, under carefully controlled conditions, can make valid judgments of comparisons of performances of different retrieval procedures.

81. Saracevic, T. Ten years of relevance experimentation: A summary and synthesis of conclusions. In The information conscious society. Proceedings of the 33rd Annual Meeting of the American Society for Information Science, 1970, 7, 33-35.

Relevance is one indication of how scientists use and treat information. Saracevic reviews some 15 relevance experiments undertaken during the last ten years, and concludes that one's knowledge of a subject area is the most significant factor in a relevance judgment. However, the report has received criticism that the author considered only experiments in artificial environments and ignored real-life relevance assessments such as the Lancaster evaluation of MEDLARS but whether or not this criticism makes Saracevic's conclusions invalid is questionable.

82. Scheffler, F. L., & March, J. F. User appraisal and cost analysis of the Aerospace Materials Information Center. (Final report) Dayton, Ohio: University of Dayton Research Unit, 1970 (AD 707 143).

Scheffler and March indicate that the average cost of input of documents at the Aerospace Materials Information Center was about $10 while searches cost between $43 and $49. Though the performance, both time- and qualitywise, of the Center was about even with other systems, the authors suggest that a modification of input and search costs could improve cost-effectiveness.

83. Seese, D. A. The systems analyst in the terminal access environment. Journal of Systems Management, 1971, 22(3), 17-19.

Seese discusses the output component of MIS and names two inhibitors to managerial acceptance of MIS. The first inhibition is the fear of middle-management of losing their positions or functions as a result of the new innovation. The second inhibition is the fear of upper-management of weaker security of information due to a broadening or breakup of formal organizational channels.

84. Senensieb, N. L. Gaining acceptance of change. Journal of Systems Management, 1971, 22(5), 8-13.

A primary reason for lack of acceptance of MIS by personnel and users is simply that they are not told why a system is designed as it is or why it works as it does. Senensieb stresses the need for communication between designers and users, and recommends procedures for gaining acceptance of change. He discusses resistance to change, methodology for selling innovation including the "sales pitch," the implementation of change, and continuing post-operation procedures.

85. Senko, M. E. Information storage and retrieval. In J. T. Too (Ed.), Advances in information systems science. Vol. 2. New York: Plenum Publishing Corporation, 1969.

Senko suggests that there is no absolute relation of mathematical measurement of relevance to actual relevance, and that just because a performance curve for an information system resembles a mathematical curve, no inherent insight about the complex factor of relevance necessarily follows. The author also gives a general discussion of ISAR systems.

86. Shilling, C. W., Bernard, J., & Tyson, J. W. Information communication among bioscientists. Washington, D.C.: Biological Sciences Communication Project, George Washington University, 1964.

Shilling et al. studied information-use patterns among researchers in 64 biological laboratories and found that a policy of unrestricted long-distance telephoning correlated highly with success in obtaining information but not with productivity. A policy of unrestricted travel privileges, however, correlated highly with success in acquiring information as well as in increased productivity.

87. Smith, W. A., Jr., Anderson, R. A., & Jennings, M. A. Experimental retrieval systems studies. (Report No. 4) Transition to on-line information and reference retrieval. (Final summary report) Bethlehem, Pa.: Center for the Information Sciences, Lehigh University, 1968 (AD 674 954).

Smith et al. describe a transition from batch-processing to on-line information and reference retrieval, and suggest that, for optimal benefit from interactive systems, the system should originate from redesign rather than from extension of pre-exsiting systems.

88. Streufert, S., & Castore, C. H. An implication for the information search concept: Effects of increasing success and failure on perceived information quality. (Tech. Report No. 9) Lafayette, Ind.: Purdue University, in cooperation with Rutgers--The State University, New Brunswick, N.J., 1968 (AD 668 529).

The authors studied the influence of increasing success and failure on user-supplied estimates of information quality and the relationship of these estimates to information-use behavior. Streufert and Castore indicate that estimates of quality initially increase and remain quite uniform until very high levels of success and failure are reached. At that point, failure-treated individuals fail to increase their estimates of information quality but success-treated individuals continue to increase their estimates of information quality. The authors suggest that managers in complex decision-making situations may tend to lose some critical judgment abilities on a steady diet of high-quality information and therefore that they should be offered an occasional failure so their assessment of information will be more moderate.

89. Taylor, R. S. Question-negotiation and information-seeking in libraries. Studies in the man-system interface in libraries. (Report No. 3) Bethlehem, Pa.: Center for the Information Sciences, Lehigh University, 1967 (AD 6[illegible] 468).

Taylor studies the process of question-negotiation in libraries and information centers. Four states of question-formulation are identified. First is the actual but unexpressed need for information, the visceral need. Second is the conscious within-brain description of the need, the conscious need. Third is the formal statement of the need, the formalized need. Fourth is the question as presented to the information system or information specialist, the compromised need. The author suggests that certain traits for intermediaries are obvious, namely empathy, sense of analogy, subject knowledge, file and collection and client knowledge.

90. Thomas, D. E., Jr. Management information systems--What happens after implementation? Proceedings of the AFIPS 1971 Spring Joint Conference, 1971, 38, 277-281.

Thomas suggests that the reason for the failure of many MISs is not because of poor design or programming but because of poor management after the system becomes operational. Though this assumption is open to question, the author continues with the recommendation for the creation of a production systems analyst group. The group would be charged with the responsibility of managing the production phase of MIS. The group's functions would include a number of tasks which can be grouped in three categories, namely, pre-processing, post-processing and coordination of information operations. The author's suggestions are relevant for organizations contemplating implementation of a management information system, though his specific recommentation may not be accepted.

91. Thompson, D. A. Interface design for an interactive information retrieval system: A literature survey and a research system description. Journal of the American Society for Information Science, 1971, 22, 361-373.

This report attempts to explore the direct transfer of a user's problem into the structure and vocabulary of an information system. The authors argue that librarians are of limited value in helping an inexperienced user formulate an appropriate search query which would be most compatible with the structure of a retrieval system. User-system interaction then is the most significant, and difficult, problem considered in interactive information systems. In this research system at Stanford, hierarchically structured index trees were displayed on a CRT in a decision-making format, and users interacted with the terminal by use of a light pen. Users indicated with the pen which alternatives seemed most appropriate to his query. The authors estimate that by using his passive rather than active vocabulary, the user increases his interaction with the system vocabulary by at least one order of magnitude. Suggested reasons for this gain are that the hierarchically-structured index appears to greatly resemble human cognitive structure, and that use of a light pen is the most basic and direct interaction with a retrieval system.

92. Varley, T. C. Data input error detection and correction procedures. Washington, D.C.: George Washington University, 1969.

Varley discusses input data errors of computer systems that result from incorrect human recording during data collection. Errors are classified by type, and the stages at which they may occur are

named. The author also discusses the procedures for detecting and correcting input errors, and the trade-offs between data worth, input accuracy, and costs. A model based on the trade-off between data accuracy and costs is suggested for the evaluation of different configurations of detection and correction procedures.

93. Vessey, H. F., & Gabelman, I. J. (Eds.). Storage and retrieval of information: A user-supplier dialogue. Proceedings of a symposium sponsored by the Avionics and Technical Information Panels, Munich, 18-30 June 1968. AGARD Conference Proceedings No. 39 (AD 697 621).

Over six international symposia have been held in the past six years on information storage and retrieval. These have focused on the needs of the documentalist or the computer operator. This collection of 16 papers, aiming to fill the gap between these two viewpoints, discusses the needs of engineers and scientists. Points of view of the user who asks for information and of the supplier who stores information for future use are given. Present operating manual and mechanical systems are discussed. State-of-the-art reviews are presented for scientific and technical aids as well as for methodology and user needs. Note especially paper 7 (On-line information storage and retrieval), paper 12 (Technical information services and user needs), and paper 14 (Interactive information processing, retrieval, and transfer).

94. Voos, H. Organizational communication: A bibliography. New Brunswick, N.J.: Rutgers University, 1967 (AD 657 647).

Voos performed an extensive literature search on reports of inter- and intra-group communication. The studies are grouped into a large number of topics such as "cognitive structure" and "decision-making," and the user is easily guided to sources most helpful to his information need. Even if one does not know what factors should be considered in the implementation of innovations, one can examine the table of contents and get a fair idea of the considerations involved.

95. Walker, D. E. Interactive bibliographic search: The user/computer interface. Montvale, N.J.: AFIPS Press, 1971.

Several computer-based systems capable of interactive bibliographic search have been developed in recent years but evaluations of them have tended to stress mechanical details or specific application procedures. Walker reports a workshop on the user/computer interface for interactive search of bibliographic data bases wherein the first

attempt was made to evaluate what happens "in front of the terminal." Papers given at the workshop were later revised for inclusion in this report. Topics covered included general design processes; command, query, and display structures; interface between data base content and query language; evaluation criteria; and identification of the user needs, feedback, and training. Critical minutes are given. An extensive bibliography on the user/computer interface is appended.

96. Walter, P. L. Information service affects communication. Journal of the American Society for Information Science, 1972, 23, 136.

In an opinion paper, Walter refers to the paper by Crawford on the communication network among scientists engaged in sleep research (Item 23), and suggests that the mere existence of an information service directed to a particular group of scientists will cause a change in the information-utilization patterns.

97. Ward, W. G. The research utilization specialist: A review and synthesis of selected literature on research development. Report Project-Rep-15. Stillwater, Okla.: Oklahoma Vocational Research Coordinating Unit, 1971 (ED 056 171).

Ward proposes that a position of Research Utilization Specialist be created for the field of research and development. The position would be one of transition between the act of research and implementation of its findings. The author synthesized both the literature and personal interviews with education research personnel, and found that: (1) there is a problem with research findings, they are seldom used; (2) one solution to the problem would be to create the professional position of Research Utilization Specialist; (3) the function of the RUS would be to recast actual research findings into a form suitable for use by practitioners. Ward considers the position desirable, and suggests for it a training program.

98. Watson, H. J. Computers can reduce management risks. Journal of Systems Management, 1971, 22(12), 13-17.

If a management information system is installed in an organization, managers should know something about its information-processing potential. Watson argues (and reasonably so) that managers should also understand how a computerized MIS can help them solve their individual problems. The author discusses the methods by which MIS can be of daily help in management decision-making.

99. Weinmeister, C. J. The science of information management. Computers and Automation, 1971, 20(4), 20-24.

The author says that, in large and highly-integrated organizations, information offices should be established at different organizational levels to prevent the flow of information from being blocked or hampered at any point.

100. Weiss, S. D. Management information systems. In C. A. Cuadra (Ed.), Annual review of information science and technology. Chicago: Encyclopedia Britannica, 1970.

In this excellent review article, Weiss relates the historical development of MIS and clarifies much of the confusion emanating from within the literature. He stresses the need for a better organized, coherent body of literature.

101. Welch, N. O. A survey of five on-line retrieval systems. Washington, D.C.: MITRE Corporation, 1968.

In this survey of five on-line information retrieval systems, Welch discusses the present state of the design art with regard to interactive user-system interfaces.

102. Wessel, C. J. Criteria for evaluating technical library effectiveness. Aslib Proceedings, 1968, 20, 455-480.

Wessel, C. J., & Moore, K. L. Criteria for evaluating the effectiveness of library operations and services. Phase III: Recommended criteria and methods for their utilization. Washington, D.C.: I. Thompson & Company, 1969 (AD 682 758).

This evaluation of the operations of Army Technical Libraries was conducted in three phases. First, a literature search was performed to ascertain the state-of-the-art for evaluation of library operations. Second, data from Army Technical Libraries were collected and analyzed as an additional aid to identification of evaluation criteria. Third, from the literature search and the data from Army Technical Libraries, various criteria were established and authenticated. Evaluation procedures stressed standard management techniques such as cost-effectiveness analysis, correlation analysis, utility analysis, Planning-Programming-Budgeting Systems (PPBS), and the Group Attainment Program (GAP). Wessel presents an interesting decision-aiding matrix for selection of evaluation criteria.

The first citation is a shorter summarization of the report by Wessel. The second citation is the complete report of Phase III by Wessel and Moore.

103. Westat Research, Inc. Evaluation of document retrieval systems: Literature perspective, measurement, technical papers. Procedural guide for the evaluation of document retrieval systems. (E. C. Bryant, Project Director). Bethesda, Md.: Westat Research, Inc., 1968. 2 Vols.

The two-volume report by Bryant et al. is a particularly strong, comprehensive, and useful discussion of cost-effectiveness methodology as applied to information systems. The report is strong for two reasons: (1) it presents a very explicit relationship between retrieval effectiveness and cost-effectiveness analysis; (2) retrieval functions are not evaluated by a broad criterion but by detailed diagnostic measures of microevaluation. The first volume of the report provides some background on evaluation of retrieval effectiveness of document retrieval systems, discusses measurement theory and practice as applied to evaluation of retrieval systems, and details mathematical and statistics theory involved in general measurements of evaluation of retrieval systems. The second volume applies very concretely the principles suggested in the first volume.

104. Williams, J. H., Jr. Functions of a man-machine interactive information retrieval system. Gaithersburg, Md.: IBM Federal Systems Division, 1970 (AD 716 954).

One problem of information retrieval is that some, if not all, concepts are referenced by more than one term. A corollary problem is that some terms refer to more than one concept. This multiple-meaning phenomenon causes the retrieval process to key on false hits and miss true hits. Hence when a user attempts to retrieve a concept expressible by more than one term, he may fail to hit if if he and the indexer use different terms. Williams discusses an automatic indexing and test retrieval system allowing free-form query and providing on-line browsing. The system, termed BROWSER, offers a sequence of steps in which man and machine alternately take action. Different levels of service, recognition of broad and narrow searches, and ranked responses are also given.

105. Willoughby, T. C. Staffing the MIS function. Computing Surveys, 1972, 4, 241-259.

Willoughby describes the staffing of the EDP department. Four aspects of staffing are discussed. First, job descriptions are described as traditional, trait analysis (specific job behavior is the result of a specific personality trait), and task analysis (ranked job-task statements are identified and grouped as job descriptions). Second, recruitment may come from personnel within the organization or from local computing schools and school systems outside the organization. Third, selection is viewed in terms of satisfactoriness (the performance of an individual on a job as seen by the organization) or of satisfaction. Fourth, the author describes the Programmer Aptitude Test (PAT), the Wonderlic Personnel Test, the Computer Programmer Aptitude Battery, and interest and personality tests. Willoughby also argues that turnover rates have been overemphasized.

106. Wimbrow, J. H. A large-scale interactive administrative system. IBM Systems Journal, 1971, 10, 260-282.

Wimbrow reports the five years of system development needed to provide an operational interactive information system to 5000 users located in 320 different geographical locations. He indicates that two factors were essential to the success of the system: (1) an operational, full-scale mockup with realistic programs for full AAS activities; (2) a training program for the system's users.

107. Withington, F. G. Trends in MIS technology. Datamation, 1970, 16, 108-119.

The author, an employee of Arthur D. Little, Inc., surveyed the hardware and software groups of Little in order to predict the technology and configuration of a 1975 MIS. He indicates that it will not be dissimilar from the MIS of today. Technological improvements such as a ten-fold increase in memory cost-performance means that user needs become of primary importance to manufacturers. A trend toward independent modular configurations of MIS is noted.

108. Wolek, F. W. The complexity of messages in science and engineering: An influence on patterns of communication. In C. E. Nelson, & D. K. Pollock (Eds.), Communication among scientists and engineers. Lexington, Mass.: Heath Lexington Books, 1970.

The paper argues that there is greater reliance on informal interpersonal communication networks in mission-oriented (or theoretical) research organizations. Wolek explores "the probability that a communication [that involves] interpersonal interaction between source and receiver varies directly with the complexity of the message communicated."

109. Wolek, F. W. Preparation for interpersonal communication. Journal of the American Society for Information Science, 1972, 3(1).

Empirical data have shown that, in an information search, users face three questions: (1) should I put my information need on standby and wait and hope for a working or accidental encounter? (2) should I try to satisfy my need from preexisting information sources? (3) should I read and understand more background about my information need before I query an expert? Wolek suggests a model for illustrating the influence of factors such as user experience and prior user knowledge on the determination of the questions. Wolek obtained the data from interviews with 35 scientists and engineers. Also discussed is the implication of the Wolek model for management support of interpersonal communication within an organization.

110. Wolk, S. Resistance to EDP: An employee-management dilemma. Data Management, 1968, 6, 44-46, 74-76.

Wolk suggests that resistance to EDP innovations arises when employees' needs are threatened; employees may or may not in fact be threatened but the important factor is that they feel threatened. The author names the four employee needs as: (1) physiological needs (food, shelter); (2) security needs (job permanence, pay raises); (3) social needs; (4) needs for self-actualization. Wolk also finds an almost unanimous resistance to EDP from experienced employees who have been with the firm for two or more years.

111. Wooster, H. An information analysis center effectiveness chrestomathy. Journal of the American Society for Information Science, 1970, 21(2), 149-159.

Wooster presents a selection of comments from the literature regarding information analysis centers (IACs). He includes statements on the criteria by which IACs should be judged, methods for ascertaining the opinions of users of IACs, the problems of IACs and guidelines for evaluating IACs.

112. Zunde, P., & Dexter, M. E. Factors affecting indexing performance. In Cooperating information societies. Proceedings of the 33rd Annual Meeting of the American Society for Information Science, 1969, 6, 313-322.

Zunde and Dexter suggest that a Flesch-rated readability-ease score is one influential factor in indexing "quality." (Quality was defined as the correlation of an individual indexer's index terms to some "standard" index terms.) The authors found that documents with Flesch reading-ease scores of approximately 40 were indexed better by student and professional indexers than were documents with significantly higher or lower reading-ease scores. But scientists indexed better with documents of significantly lower readability-ease scores. This indicates that indexing quality is dependent to a large extent on an individual's range of readability. Further research in this area should be conducted, as there are many factors, both people-oriented and document-oriented, which affect indexing.